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20th Congress of the International Union for Quaternary Research (INQUA)



Submitted to: 20th Congress of the International Union for Quaternary Research (INQUA)

Title

A 1000-year-long documentary record of the lower Yellow River ice-jam floods and its climatic implications

Abstract

The Yellow River floodplain is a low-lying landmass, which is remarkably susceptible to excessive precipitation and prone to floods. Therefore, it has a strong association with calamity and has traditionally been regarded as "China's sorrow." Also, given its immense ecological, societal, and economic importance, the Yellow River floodplain contributes significantly to human welfare, which has colloquially known as the birthplace of Chinese civilization. Therefore, a deeper understanding of flooding frequency in this area is especially important for the assessment of socio-economic risks associated with future climate changes. The late 20th century contained a number of catastrophic floods in the lower Yellow River, which has exerted devastating impacts on the human livelihood. However, the long-term context of apparently anomalous flooding events witnessed in recent decades has received very limited attention.

To better understand the nature, evolution, and driving mechanisms of river floods, it is widely recognised that the instrumental time series should be placed within a longer time framework. Here we present a 1000-year-long documentary record of ice-jam floods of the lower Yellow River by compiling flooding events in terms of levee breaches and overflows during the early spring months as documented in official dynamic histories. A time series with a yearly resolution was formed by using a binary expression with "1" denoting the presence and "0" the absence of flooding event for a year. The flood frequency is computed by convolution with a 31-year-wide window. Our results reveal an increasing frequency of ice-jam floods since AD 1855 when an avulsion occurred, and the river shifted northward to its current channel. As the occurrence of the ice-jam floods is essentially induced by a deepened temperature gradient between the inland and maritime region in the lower Yellow River area during the early spring months (January-March), we ascribe the increasing frequency of ice-jam floods to the prolonged negative phase of ENSO (i.e., La Nina). Our finding implies the global teleconnection of terrestrial hydrological systems to the ENSO cycles.

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